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Producing AVOCADO In Hawaii

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PRODUCING AVOCADO in HAWAII

Warren Yee*

The avocado (*Persea americana*) is among the earliest of the fruit trees brought to the Hawaiian Islands. Records indicate introduction early in the nineteenth century by Don Francisco de Paulo Marin. By 1855 trees which are believed to be of Guatemalan origin had become quite common on Oahu and were transported to the other islands.

Avocado ranks fourth among fruits commercially produced for fresh consumption. In addition, many farm and city homes have trees in the yard to supply family and nearby market needs. The largest commercial planting ever established in the Hawaiian Islands was that of the Hawaiian Avocado Company near Waimea, Oahu. The acreage in avocados reached its peak, in 1941 with approximately 500 acres planted, but since then has declined. Total acreage in the State is now estimated at less than 200 acres.

Most of the fruits produced are consumed in Hawaii. Statistics of Hawaiian Agriculture show that heaviest production of fruits generally occurs during the months from January–April and lowest production from June–September. At present the principal growing area is in the Kona district of Hawaii. Many of the avocados marketed from this district are of seedling origin.

As early as 1904–1907, the Hawaii Agricultural Experiment Station made test shipments of avocados to West Coast cities as far north as Vancouver and to other cities including Chicago, New York, and Washington. In 1910 however, the Mediterranean fruit fly became established in Hawaii, and to prevent its introduction to the mainland federal and state quarantines were imposed against fresh fruit shipments from the Islands. However, shipments can be made now after a disinfestation treatment which destroys any fruit fly infestations.

The Division of Marketing of the State Department of Agriculture has set up grade standards for commercial export shipments. Avocado must be graded Hawaii No. 1 or better, to be shipped. In addition, the minimum oil content of the avocados in any lot must be 12 percent or higher. Further information on characteristics of each grade can be obtained from the above agency. Small individual gift packages, however, are not affected by these grade restrictions.

RACES

Avocados have been classified into 3 races: Guatemalan, Mexican and West Indian. The principal races in Hawaii are the West Indian and Gua-

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temalan and hybrids or crosses of these two. Avocados in the Mexican group are not commonly cultivated in Hawaii. However, a hybrid of this race, the Fuerte variety is grown to a limited extent in home gardens.

The West Indian race is claimed to be indigenous to the lowlands of Central America and northern parts of South America. Members of this group are more tolerant to heat than either the Guatemalan or Mexican races. In the Islands, West Indian avocados are often referred to as *Summer pears* since fruiting occurs during the Summer. Characteristics of this group include fruits with skins varying from light green or reddish-black and thin to medium in thickness. Lenticels vary from depressed, smooth or raised. Leaves are usually light green in color. The seed is often loose in the cavity.

The Guatemalan race is considered native to the highlands of Central America. Consequently, they are more tolerant to cold. Fruiting occurs from Fall to the following Spring. They are often called *Alligator pears* because of their thick, hard and often pebbled skin. The rough skin often times camouflages the raised lenticels. In addition to their tough skin, fruits of green-skinned varieties are dark green in color and the seed generally fits tightly in the cavity. Newly emerging leaves of most varieties are reddish or copper color but turn dark green at maturity.

The hybrids or crosses of the Guatemalan and West Indian races may have various combinations of characteristics of these races. For instance, there may be a typical smooth-skinned West Indian type of avocado fruiting in February. An example appears to be the Nishikawa variety.

VARIETIES

The Hawaiian Agricultural Experiment Station had as many as 65 Hawaiian varieties under observation in 1911. The most popular was the McDonald. The McDonald is thought to be a parent of some of our outstanding seedling avocados. The most important of these is the Beardslee. Other varieties include Nutmeg, Holt, Wilder, Case, the Lehua and Ilialu. Many avocados imported into the State have adapted themselves well. Among them are the Linda, Nabal, Panchoy, Itzamna and Kaguah. All of these except Kaguah are being marketed in Honolulu.

ORIGIN AND DESCRIPTION OF VARIETIES

The Beardslee (Fig. 1) was grown from a seed of the McDonald. It was planted December 18, 1911, by L. C. Ables, at 1627 Kewalo St., Honolulu. Hence it is frequently called the Ables. The variety was named in 1919 in honor of Admiral Beardslee. Fruit characteristics:

form broadly oval; color, green; skin, moderately thick, granular, and woody; weight 1½–2½ pounds; flesh, yellow tinged with green next to rind; flavor, pleasant and nutty; seed, medium to large; season, September to November. Oil content, above 12 percent.

The **Cho** is a seedling from Kahaluu, Kona. Tree and fruit characteristics indicate it to be a Guatemalan hybrid. The original tree is a heavy regular bearer. Fruit characteristics: form, rounded-obovate; color, green; surface, slightly rough; skin, medium thick; weight, 1–1½ pounds; flesh, yellow; flavor, slightly nutty; seed, large; season, November to December. Oil content, about 13.9 percent.

The **Fuerte** (Fig. 2) is believed to be a seedling of Guatemalan x Mexican parentage. It was introduced into the U. S. in 1911 from Atlixco, Mexico, by Carl Schmidt. It was brought to Hawaii by the Hawaii Agricultural Experiment Station in 1921. W. D. Baldwin, of Haiku, Maui, also may have brought this variety in about the same time. The variety is not propagated extensively in the state, probably because it is susceptible to anthracnose and a local preference for larger sized fruits. Fruit characteristics: form, pyriform; color, green; skin, slightly pebbled, thin and pliable; weight, 10–16 ounces; flesh, creamy yellow; flavor, moderately rich; seed, small; season, November to April. Oil content, 16.4–29.2 percent.

The **Fujikawa** is a Guatemalan type seedling planted by the late Satomi Fujikawa at Honaunau, Kona. It is a very heavy bearer with fruits of good cold storage keeping quality. Fruit characteristics: form, almost spherical; weight, 1¼–1½ pounds; color, green; skin, medium thick and slightly rough; seed, small; flesh, light yellow; flavor, rich and nutty; season, February to May. Oil content, 16.7–27 percent.

The **Hass** is a Guatemalan type grown from seed planted by R. G. Hass at La Habra Heights, California, in 1926. The variety is not grown extensively in the State. Fruit characteristics: form, oval to slightly pyriform; color, dark purple to black; skin, heavily pebbled and leathery; weight, 6–10 ounces; flesh, yellow; flavor, rich and nutty; seed, small to medium; season, March to May. Oil content, 27–31 percent.

Hayes (7315) Fig. 3) is an open pollinated seedling selection of Hass from the College of Tropical Agriculture Branch Station at Poamoho, Oahu. Like the Hass, the shape is oval to pyriform; color, reddish-purple to dark purple; skin, pebbled and leathery; weight, 1/2–3/4 pound; flesh, pale yellow; flavor, rich and nutty; seed, small to medium; season, March to May. Oil content, about 20.5–21.6 percent.

The **Healani** is a seedling planted by Howard Cooper in Hana, Maui. The tree and fruit characteristics indicates it to be of West Indian origin. Fruit characteristics: form, oblong-oval; color, dark purple when mature; surface, very smooth; skin, very thin; weight, 3/4–1 pound; flesh, yellow;

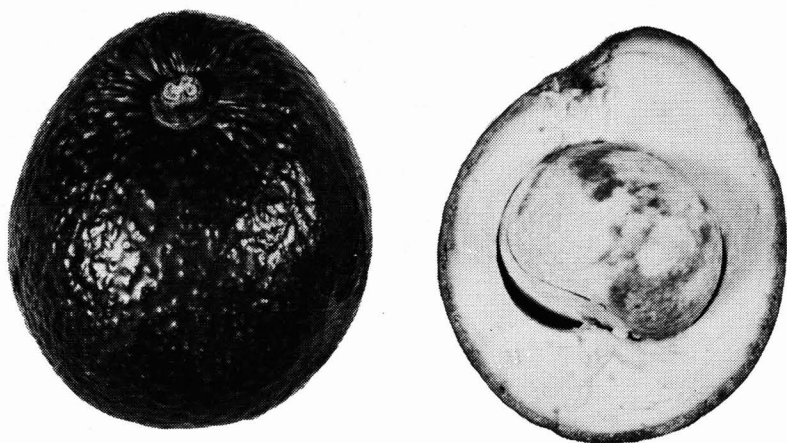


Figure 1. Beardslee

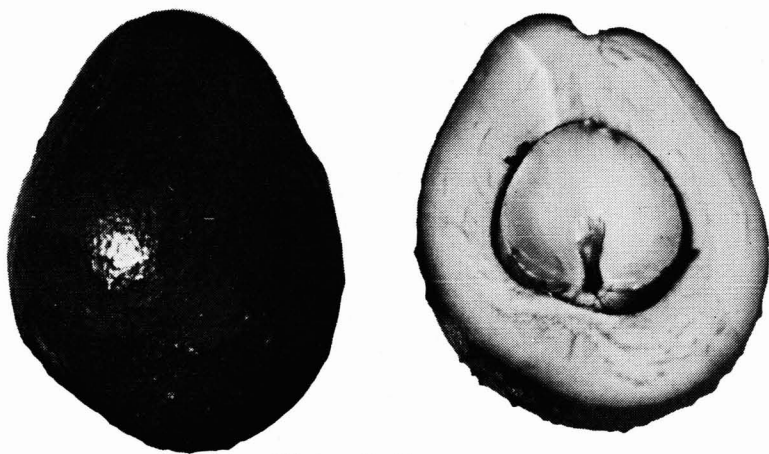


Figure 2. Fuerte

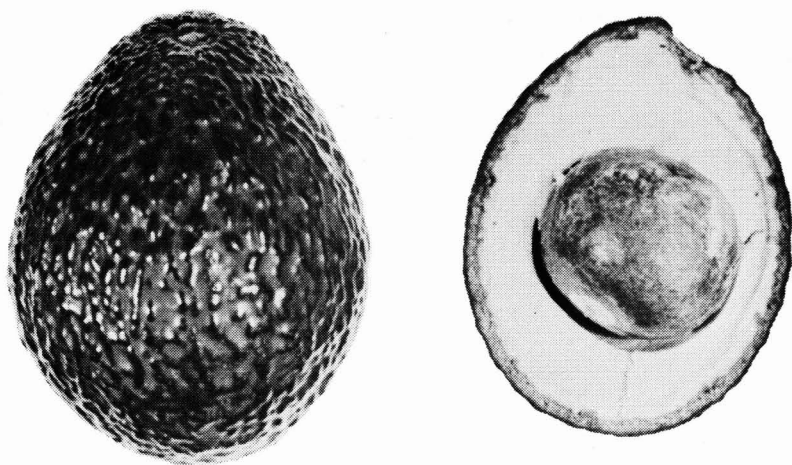


Figure 3. Hayes (7315)

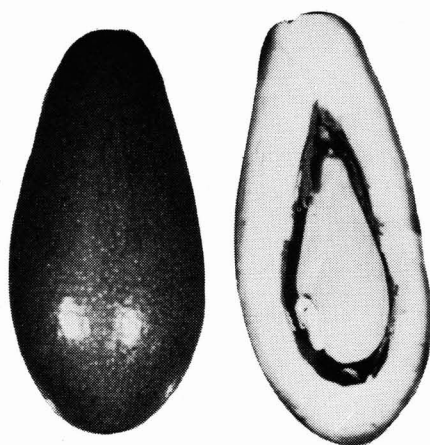


Figure 4. Hulumanu

flavor, mild and pleasant; seed, small-medium; season, August to September. Oil content, about 14.8 percent.

The **Hulumanu** (Fig. 4) is a West Indian seedling discovered in 1910, growing at Moanalua. The variety is still widespread and one of the better known summer fruiting varieties. It is a light to moderate bearer. Fruit characteristics: form, oblong-ovate; color, light green; skin, smooth and thin; weight, $1\frac{1}{2}$ – $1\frac{3}{4}$ pounds; flesh, yellow; flavor, nutty; seed, medium; season, July to August. Oil content, about 14 percent.

The **Ilialu** is a seedling of Guatemalan and West Indian parentage. G. P. Wilder is credited for originating this seedling in 1914. The variety is a heavy bearer with fruits of good keeping and shipping quality but is susceptible to mite infestation. Fruit characteristics: form, pyriform; color, dark green; surface, rough; skin, thick and granular; weight, $\frac{3}{4}$ –1 pound; flesh, light yellow; flavor, nutty; seed, small-medium; season, October to December. Oil content, 24.6–27 percent.

The **Itzamna** (Fig. 5) is a Guatemalan variety introduced by the United States Department of Agriculture. It has become a popular variety because of its heavy and early bearing characteristics. Fruit characteristics: form, pyriform; color, green; skin, rough and fairly thick; weight, $1\frac{1}{2}$ pounds; flesh, yellow; flavor, nutty; seed, large; season, May to July. Oil content, 15–23 percent.

The **Kahaluu** (Fig. 6) is a seedling discovered in the Kona district of Hawaii. Fruit characteristics: form, rounded-obovate; weight, about $\frac{3}{4}$ pound; color, green; surface, smooth; skin, thin to medium thickness; seed, small to medium; flesh, yellow; flavor, rich and nutty; season, October to November. Oil content, 17–31 percent. A light bearer in most places.

The **Linda** (Fig. 7) is a Guatemalan variety introduced by E. E. Night to California in 1914. There is no record of its first introduction to the State. The variety is well distributed throughout the Islands, however. The tree is a regular bearer with moderate to heavy crops. Fruit characteristics: form, round to oblong; color, purple when mature; surface, rough; rind, medium-thick; weight, $1\frac{1}{2}$ – $2\frac{1}{2}$ pounds; flesh, light yellow tinged with green next to rind; flavor, very mild; seed, small; season, March to May. Oil content, about 12 percent.

The **Masami** (Fig. 8) is a seedling from Masami Ohata's farm at Kealahou, Kona. It has borne crops in Kona annually. Fruit characteristics: form, pyriform; color, attractive shiny black when fully mature; skin, thin and smooth; weight, $\frac{1}{2}$ –1 pound; flesh, light yellow; flavor, mild and pleasant; seed, medium to large; season, April to June. Oil content, about 19.4 percent or lower. It is an annual bearer in Kona. Ripe fruits have good cold storage keeping quality. In some locations bearing is so heavy that fruiting occurs in alternate years.

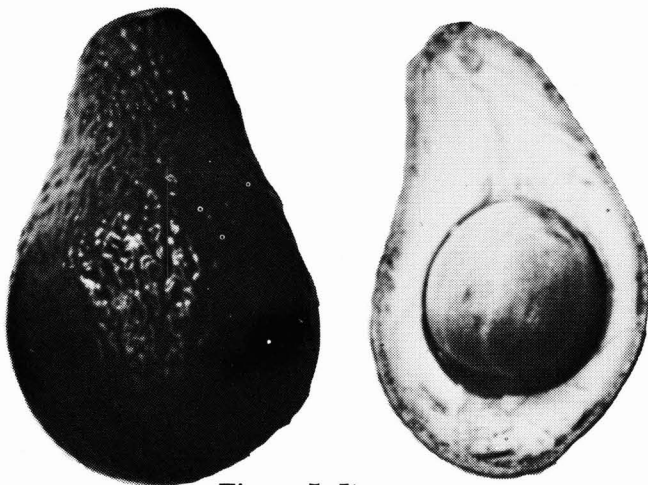


Figure 5. Itzamna

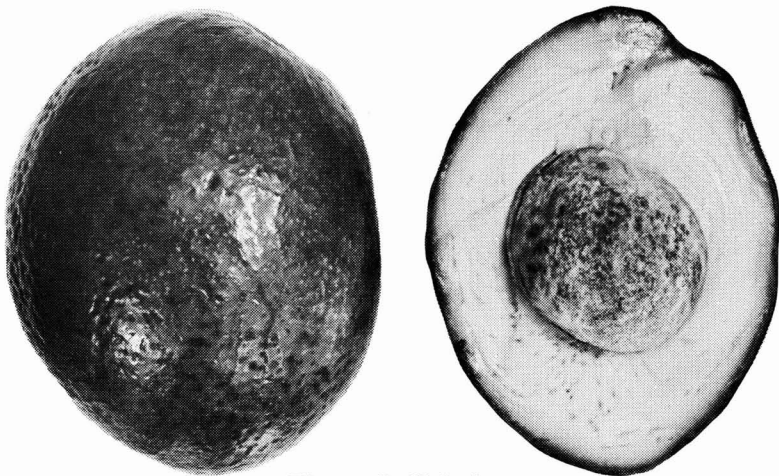


Figure 6. Kahaluu

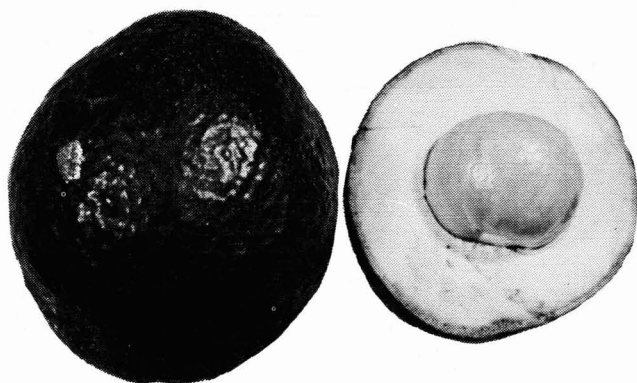


Figure 7. Linda



Figure 8. Masami

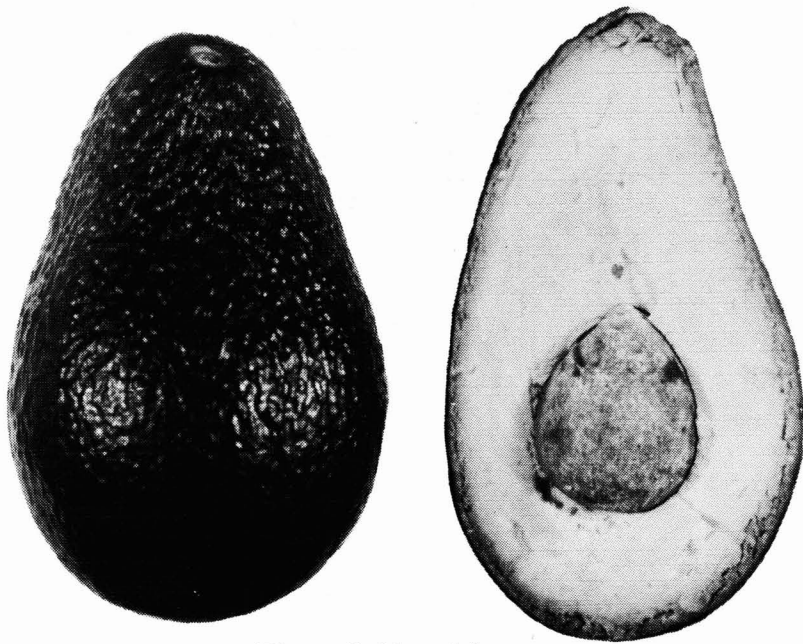


Figure 9. Murashige

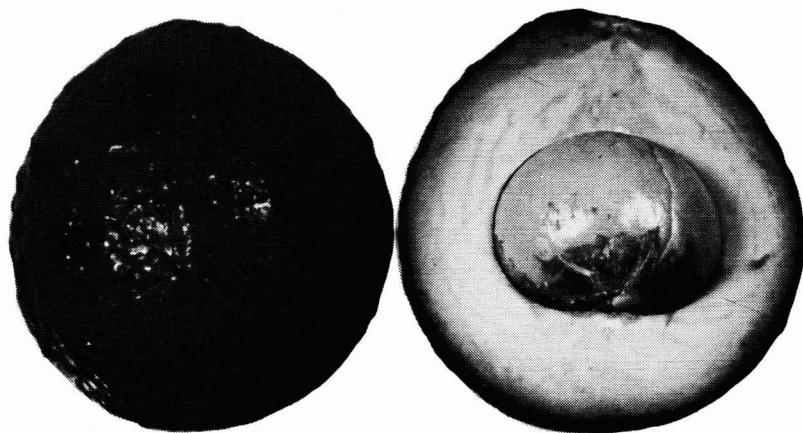


Figure 10. Nabal

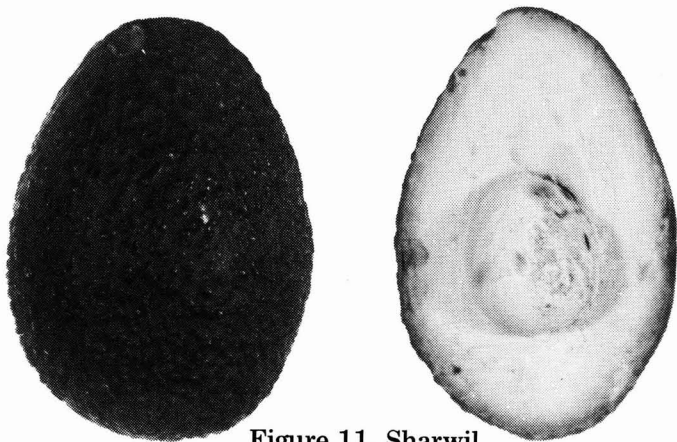


Figure 11. Sharwil

The **McDonald** was grown from a seed imported from Guatemala by Admiral Beardslee in 1891. The tree was planted at 1402 Punahou Street by Judge Wiedman. Fruit characteristics: form, spherical; color, dark purple to black; skin, highly pebbled, thick and granular; weight, 8-66 ounces; flesh, yellow; flavor, rich and nutty; seed, large; season, May to August.

Murashige (Fig. 9) is a seedling that seems well adapted to most areas. Fruit characteristics: form, pyriform; weight, 1½-2 pounds; color, dark green; surface, rough; skin, thick; seed, small; flesh, light yellow; flavor, mild to slightly nutty; season, April to August. Oil content, about 20 percent. A very heavy bearer.

The **Nabal** (Fig. 10) is a Guatemalan variety introduced by F. W. Popenoe from Antigua, Guatemala, in 1917. It was brought to Hawaii by the Hawaii Agricultural Experiment Station in 1919 as one of 22 varieties received from the Agricultural Research Service. Fruit characteristics: form, almost spherical; color, green; surface, nearly smooth; rind, medium thick; weight, 1-1½ pounds; flesh, yellow; flavor, good; seed, medium size; season, March to July. Oil content, 13-15 percent. A very heavy bearer but tends to have crops biennially.

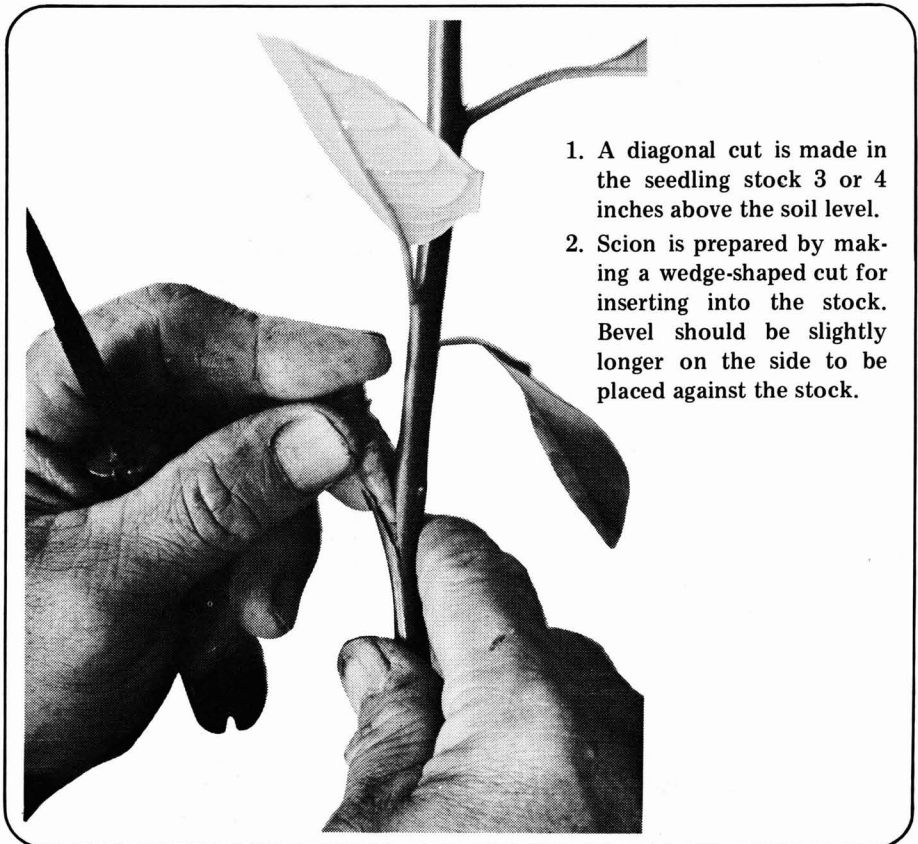
Sharwil (Fig. 11) is a relatively new introduction into Hawaii from Australia that has been well accepted by home gardeners. Fruit characteristics: form, oval; weight, 1/2-1¼ pound; color, green; surface, rough; skin, medium; seed, small; flesh, greenish yellow; flavor, rich and nutty; season, March to May. Ripe fruits keep well in cold storage.

PROPAGATION

The avocado is propagated by various methods. As yet, it has not been found practical to produce new plants by cuttings, layering, or budding in Hawaii. Grafting is most easily accomplished between the months of December through March.

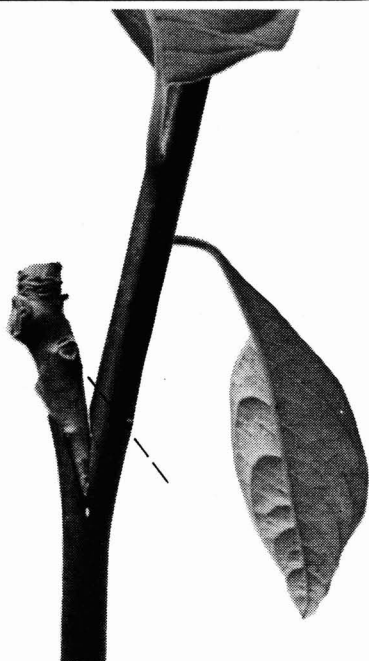
The Side Wedge Graft

The side wedge graft method is the most popular means of propagating avocado for several reasons: (1) less skill is required in selection of scion wood; (2) it is easier to make the union and a greater exposure of cambium tissue is possible; (3) it is possible to set the side wedge graft when the bark is too tight for budding.



1. A diagonal cut is made in the seedling stock 3 or 4 inches above the soil level.
2. Scion is prepared by making a wedge-shaped cut for inserting into the stock. Bevel should be slightly longer on the side to be placed against the stock.

3. Scion in place, with cambium tissues of both scion and stock perfectly matched. Ready for tying and waxing. The top should not be removed until scion growth starts; then remove the top at the broken line.

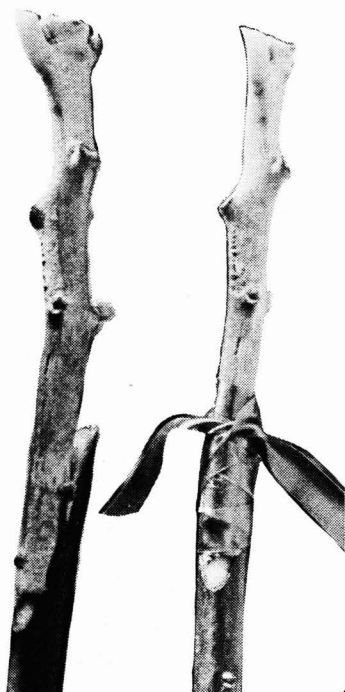


Whip Graft

The whip graft is another method of grafting. The technique requires removal of the entire top of the seedling.



1. From a point about 3 inches above the soil line, pull the knife upward so that a smooth, diagonal cut $1\frac{1}{2}$ inches long is made on the stock.
2. Place knife at X and cut (do not split) the stock about $\frac{1}{2}$ -inch downward and parallel to stock.
3. Preparing scion: a diagonal cut is made, and a half-inch cut is made into the open diagonal surface similar to the stock.
4. Place cut surface of scion and stock together. Press downward until the vertical cuts lock firmly. Tie and wax.



FERTILIZATION

Trees should be kept healthy by application of fertilizer as needed. A tree with a heavy crop of fruits will require more fertilizer than a tree with a light crop. A complete fertilizer containing the three major elements, nitrogen (N) phosphorus (P), and potassium (K) is usually used. An example of such a fertilizer is the General Garden Fertilizer 10-10-10. During the first year, a small grafted tree will be given approximately one half to one pound of fertilizer. The fertilizer is divided into three or four applications:

At planting time	1-2 oz.
4 months later	2-4 oz.
8 months later	4-6 oz.
12 months later	6-8 oz.

Usually, an extra handful of super phosphate fertilizer is placed at the bottom of the hole at the time of planting.

In the second year, the amount of fertilizer may be twice the amount of the first year. The amount is divided into three or four applications spaced equally apart.

After the second year, a rule-of-thumb method is used as a guide: A tree should be fertilized with a minimum of one pound of fertilizer for every inch of diameter of the tree trunk. In many instances however, as in the case of hot and dry areas, or areas where the soil is poor or is *aa*, the amount is doubled so that a tree with a ten-inch diameter trunk will receive twenty pounds for the year. In most instances a 10-10-10 fertilizer containing 10 percent nitrogen, 20 percent phosphoric acid (P_2O_5) and 10 percent potash (K_2O) should be sufficient for normal growth of trees.

In the event there is zinc deficiency, one pound of zinc sulfate per 100 gallons of water is recommended as a foliar spray.

In commercial orchards fertilization of bearing trees can be based on leaf analysis. Leaf samples taken for diagnosis should be mature terminal leaves 5-7 months old, from the spring growth flush of nonfruiting branches of average growing trees. The suggested levels recommended as a guide for adequate nutrition on a dry matter basis by some reports are as follows:

Nitrogen	1.6 - 2.0%
Phosphorous	0.08- 0.25%
Potassium	0.75- 2.0%
Calcium	1.00- 3.0%
Magnesium	0.25- 0.80%

PLANTING DISTANCE

Avocados are spaced in the orchard at distances ranging between 25 and 35 feet in permanent plantings. Variety is probably one of the principle factors determining the spacing between trees. For example, Fuerte avocado trees may be spaced about 25 feet apart, while the Beardslee would be spaced at a distance of approximately 30-35 feet in the orchard. Some of the other factors which should be considered in determining planting distances between trees are soil, contour, elevation, and rainfall.

Harvesting

Unlike many fruits, avocados are never picked full ripe on the tree, but must be picked mature green and allowed to ripen off the tree. Some varieties like the Fuerte can be left on the tree at the mature green stage for a long time. Others like the Hulumanu must be harvested within a month or the fruits drop to the ground. Fruits harvested early in the season are usually lower in oil content than those harvested in mid season or later.

There are several indicators when avocados are the proper stage for harvesting. These are: (1) Fruits which have attained full size and flavor begin to fall off the tree; (2) Green varieties lose their brightness or bloom and changes to a dull green color; dark or black colored varieties such as Masami begin to change color; (3) Generally, fruits mature approximately the same time each year; (4) Rat damage to fruits is often a good indication that crop is mature; (5) Fruits do not shrivel when harvested.

Yields

Yield per acre is difficult to determine in Hawaii because many orchards are intercropped with coffee. In addition most avocado orchards are small with several varieties or seedlings being cultivated. In 1975 the State estimated average yield per bearing acre was 11,300 pounds. In 1976 it was 9,300 pounds. It is likely that with varietal orchards of heavy bearing varieties with large fruits such as Itzamna, Murashige, and Fujikawa that yields would be higher.

Bearing

The bearing season for avocados vary with location and climate but generally the fruiting season of a variety occurs fairly constant each year. With some varieties the season occurs over a longer period than others. An example is the Itzamna variety which is generally fully mature in June or July yet it is quite common to harvest fruits that are of acceptable eating quality as early as April and as late as August. If harvested



Figure 12. Flowering and fruiting occurs at the same time with some varieties.

too soon, shrivelling and rotting of the fruit occurs before ripening is completed.

Alternate bearing occurs with some avocado varieties. Among them are Fuerte and Nabal. On the other hand, Itzamna and Hayes (7315) are considered reliable annual bearing varieties. Climate and cultural practices also seem to affect alternate bearing of some varieties. For example, the Masami has borne fruits annually at the Captain Cook, Kona branch station whereas the same variety has borne heavy crops in alternate years at Poamoho, Oahu and Olinda, Maui.

FLOWERING BEHAVIOR

All varieties can be placed in two groups with reference to the normal time and sequence of the opening and closing of the flowers. In group A, the first opening of the flower occurs in the morning to noon during which time the pistil is receptive but pollen is not discharged. In group B, the flower opens for the first time in the afternoon. In both groups a second opening of the flowers occurs on the following day. At this time the pistil is no longer receptive but the pollen is shed in the afternoon for A-type and in the morning for B-type varieties. Studies have been made regarding the behavior of avocado varieties growing in the Hawai-

ian Islands relative to time of opening of flowers. The limited findings are in accord with the reports of workers on the mainland.

For home gardeners in large residential communities there are enough trees of both A and B types in the islands to permit adequate cross pollination for fruit set.

Avocado classification according to flower type

Type A	Type B	
Hass	Beardslee	Linda
Hulumanu	Fuerte	McDonald
Ilialu	Itzamna	Nabal
Kaguah	Kahaluu	Yamagata

DETERMINING RIPENESS

Ripeness or the proper time for eating avocados can be determined very easily if all avocado varieties responded similarly when squeezed gently to see if the fruit is beginning to soften. However, this is not the case with avocados. The skin of some avocados is so firm and hard that ripeness cannot be determined by squeezing the fruit. In these instances, ripeness is determined by removing the stem and sticking a toothpick into the fruit at that point. If the fruit is ready to eat the toothpick will go through the soft flesh. If there is difficulty or resistance, the fruit is not ready to be eaten.

Often avocados shrivel before they can be eaten. This is an indication of harvesting prematurely.

Avocado Ripening and Storage

The ripening and storage of avocados vary with the variety. Fully mature green avocados usually ripen faster than those picked prematurely. In Florida, the best ripening temperature range is between 55° F to 75° F. Generally 60° F was found to be ideal for the West Indian, Guatemalan as well as hybrid varieties tested.

The optimum storage temperature with the Florida varieties tested was 40° F for those considered cold tolerant and 55° F for those that were considered cold intolerant or susceptible to cold injury. As a group, those of West Indian origin were the most susceptible to chilling injury.

Shipping

All avocados shipped to the mainland United States except the State of Alaska must be fumigated to destroy possible fruit fly infestations.

To accomplish this, fruits are fumigated with methyl bromide at 2 pounds per 1000 cubic feet at atmospheric pressure for 4 hours at a minimum fruit temperature of 70° F. The treatment chamber is set up at the Plant Quarantine Division of the Hawaii State Department of Agriculture. A moderate charge is made for each batch of fruits fumigated by the inspection service.

One of the problems with the methyl bromide treatment is that all avocados do not tolerate the fumigation treatment. Surface blackening or pitting occurs with some varieties. If the damage is mild, fruits will ripen normally. Varieties which have shown tolerance to the treatment include: Coban, Frowe, Hayes (7315), Itzamna, Kahuluu, Kashlan, Lehua and Mac Arthur. Due to the severity of this treatment, commercial shipments of avocados to the mainland have not developed. On the other hand, shipments of avocados from California to Hawaii are increasing. In 1977, 269,000 pounds were imported to Hawaii as compared to 757,000 pounds locally produced and marketed in Hawaii.

DISEASES

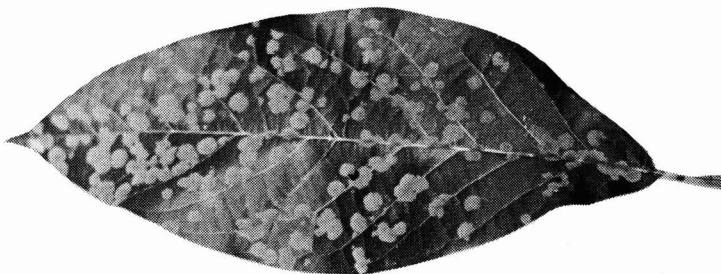
Among the diseases reported present are avocado root rot (*Phytophthora cinnamomi* Rands), surface rot (*Dothiorella gregaria* Saccardo), scab (*Sphaceloma perseae* Jenkins), anthracnose (*Colletotrichum gloeosporioides* Penzig) and algal spot (*Cephaleuros virescens* Kunze).

Avocado Root Rot is caused by a fungus and is associated with the so-called "decline disease" in avocado orchards. It is especially prevalent in sections with poor soil drainage or where there is a combination of poor drainage and high rainfall. It is widespread in the State. It has been reported that *Phytophthora cinnamomi* has been found in healthy trees but doing little damage. However, when excessive water was applied, to a point of "waterlogging" the soil, the trees succumbed to the "decline disease." Symptoms: yellow leaves, sparse foliage, wilting of the leaves with slight or no new growth, and dieback of twigs; eventually the larger branches or the whole tree dies. Control: at present, prevention of the conditions conducive to avocado root rot seems to be the best method of control. This may be accomplished by: (1) Selecting site with good soil drainage; (2) Obtaining disease free plants produced in sterilized or clean soil; (3) Planting in areas not known to have *P. cinnamomi* as a problem; and (4) Using a system of irrigation other than furrow irrigation which prevents the spread of the fungus.

Anthracnose or Black Spot is a fungus disease found throughout the Islands. It is seldom noticed until the fruit begins to mature or ripen and is commonly associated with rot organisms that attack overripe or bruised fruits. Symptoms: on green-colored fruit, dark brown or olive



**Figure 13. Stem rot on Itzamna variety grown in Kona.
Left, healthy fruit.**



**Figure 14. Algal spot in avocado is a common
problem in wet areas.**

colored spots appear; on dark-colored fruit, a lighter than natural spot appears. If the fruit is kept in a moist atmosphere, pustules of pink spores appear. The spore masses may spread, forming a pink layer over the surface. The rot quickly penetrates the entire body of the fruit and is therefore slightly different from other rots which are usually confined to the surface during the early stages. Anthracnose may also be associated with stem rot (Fig. 13) which initially may be caused by *Phytophthora*.

Control: copper sprays seem to give satisfactory control of this disease. One of the more common spray materials on hand is basic copper sulfate which is applied at the rate of 3-4 pounds per 100 gallons of water or approximately 2½-5 tablespoons to a gallon. Spraying should be spaced about a month apart, three months before maturity. Where rainfall is heavy, more frequent application is advisable. Anthracnose can also be avoided by planting of avocado varieties that are not susceptible to the disease or by restricting plantings to relatively dry areas.

Surface Rot is a fungus disease which has been found on fruit samples in Kamuela and Kona, Hawaii. The disease is probable more widespread than it seems. The disease organism is generally found on dead wood, dead leaf tips, and debris. Symptoms: small brown spots which enlarge and envelope large sections of surface areas. Later the flesh is affected and takes on a brown discoloration as well as an offensive odor. The disease may also induce stem-end rot or cause fruit to drop. **Control:** remove dead wood and debris.

Scab is a fungus disease attacking both fruits and foliage. Symptoms: hard, scab-like tissue on fruits, leaves and twigs. **Control:** Plant resistant varieties such as Itzamna and Linda.

Algal Spot is a disease found on leaves of trees growing in damp, shady locations. Symptoms: reddish brown cushion-like spots of varying sizes up to 1/8 inch.

Surface rot, scab and algal spot can be treated with copper containing sprays such as basic copper sulfate or bordeaux as with anthracnose.

INSECTS AND MITES

Scales, thrips, beetles, and the fruit flies are the insects attacking the avocado. However, since they are not a major problem, spraying or dusting for insect control is not a common practice. There are occasions, however, when a small outbreak of one or more of the above-mentioned pests may attack a planting. In the event control measures are desirable, the following recommendations are suggested:

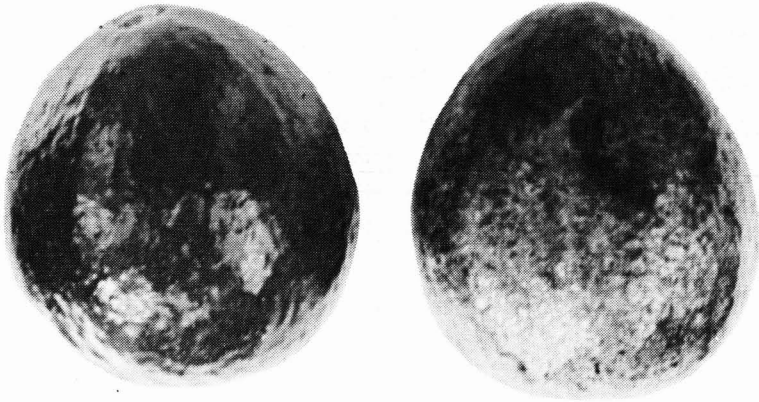
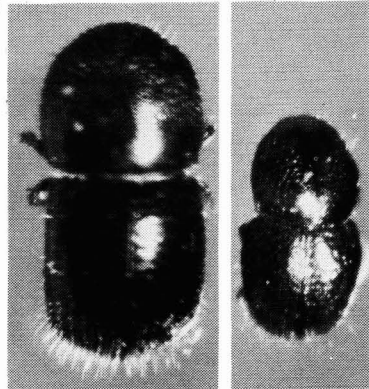


Figure 15. Some varieties are more susceptible to thrip injury (right fruit) than others.



Photo: Courtesy of Arnold H. Hara



Female

Male

Figure 16. Black Twig Borer damage on avocado branch.

Photo: Courtesy of Arnold H. Hara

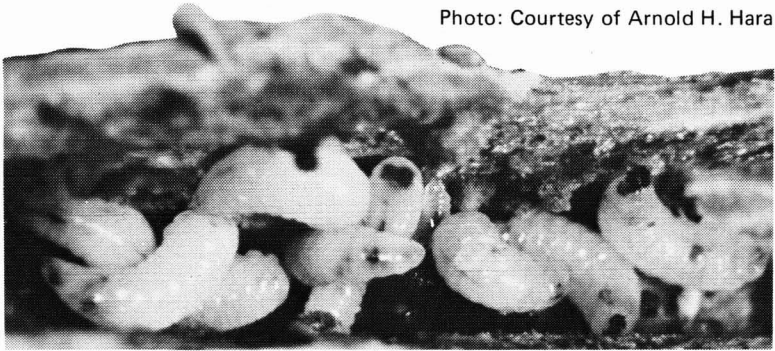


Figure 17. Larvae of Black Twig Borer in branch of tree.

Scales—There may be several kinds of scales attacking the avocado. Parasites and predacious insects usually keep them under control. If there is a need to spray, however, a summer oil emulsion such Volck oil supreme spray may be used.

Thrips—These may cause some damage to fruits. Affected areas turn a grayish brown. Control is obtained by spraying four pounds of 25 percent wettable malathion to 100 gallons of water, or 4 tablespoons to a gallon.

Beetles—The Chinese rose beetle is most injurious to young plants. The beetle eats the leaves, often leaving only the veins or skeleton. Control is obtained by spraying 4 pounds of 25 percent wettable malathion in 100 gallons of water at 7 to 10 day intervals, or 4 tablespoons to a gallon. The black twig borer can also be a problem with avocados. It seems that this insect is selective as to trees into which it bores.

Fruit Flies—The oriental fruit fly is another pest of avocados. However, the fruit fly does not cause serious fruit damage at present. The parasite *Opius oophilus* Fullaway which was introduced to reduce the fly population has been very effective in reducing damage caused by fruit fly larvae. Thick rinded varieties are less susceptible to fly damage than those having a thin rind.

Mites

Mites can also cause considerable scarring of fruits and damage to leaves. The feeding of mites by sucking the juice out of the tissue can cause a yellowish brown discoloration of the leaves and fruit. Control is best obtained by spraying 5-6 pounds of wettable sulfur in 100 gallons of water or 5-6 tablespoons per gallon.

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